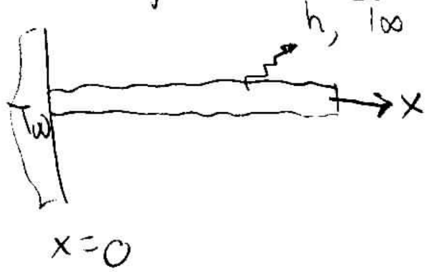
How long should a pin be?



Tempting to say $L \to \infty$

True for math, but not realistic.

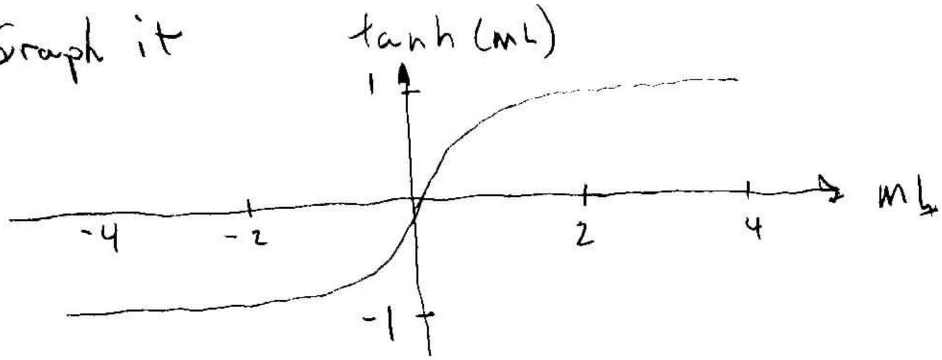
One the fin temp is $\approx T_\infty$ it contributes little.
So cut it off.
Also, really long fins make it harder for fluid flow.

Consider looking at

$$Q_{ratio} = \frac{q_{\text{finite length fin}}}{q_{\infty \text{ length fin}}} = \frac{\sqrt{hPKA_c}\,(T_b - T_\infty)\tanh mL}{\sqrt{hPKA_c}\,(T_b - T_\infty)}$$

$$= \tanh mL$$

Graph it



mL	tanh (mL)
0.1	0.1
0.5	0.462
1.0	0.762
2.0	0.964
2.5	0.987
3.0	0.995
4.0	0.999
5.0	1.000

$mL = 5$ essentially ∞-long pin

$mL = 2$ close to ∞ long pin

$mL \approx 1$ reasonable compromise
($\frac{1}{2}$ the material savings, $\frac{3}{4}$ of ∞-long fin)

Going from $mL = 5$ to $mL = 2.5$ minimal drop for heat transfer

Comment on T-profile over cross section area is ¢.
When is this really true?

Thin materials!
Like car and refrig. units.

A_c has
$T \approx$ ¢ ?
Always?

Answer: $\frac{h L_c}{k} < 0.2$ – L_c is a characteristic length or dimension of an object.
– how big is a bird?
human?
fly?
snake?

later today!

Remember

$$q_{fin} = \frac{T_b - T_\infty}{R} = h A_{fin} \eta_{fin} (T_b - T_\infty)$$

you want the smallest R value possible for a heat sink.

Compare to "R value" for household insulation.

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